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February 9, 2010

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Michael J. Graham
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RE: APPROVAL WITH MODIFICATION
INVESTIGATION REPORT FOR SANDIA CANYON
LOS ALAMOS NATIONAL LABORATORY
EPA ID #NM0890010515
HWB-LANL-09-079

Dear Messrs. Rael and Graham:

The New Mexico Environment Department (NMED) is in receipt of the United States Department of Energy (DOE) and Los Alamos National Security, L.L.C.'s (LANS) (collectively, the Permittees) document entitled *Investigation Report for Sandia Canyon* (Report) dated October 2009 and referenced by EP2009-0516. NMED has reviewed the Report and hereby issues this Approval with Modification. NMED provides the following comments and direction.

1. The Permittees do not have sufficient data or information to conclude that the nature and extent of hexavalent chromium [Cr(VI)] contamination in intermediate and regional groundwater have been determined. Based on the information provided in the Report, the extent and characteristics of the Cr(VI) reservoir in the intermediate perched zone, as well as the lateral and vertical extent of Cr(VI) contaminant plume in the regional aquifer, have not yet been determined. In order to address these and other issues noted in this response, the Permittees must submit a Phase II Sandia Canyon Investigation Work Plan (Plan). The Plan must propose, in detail, investigation actions specific to the installation

of additional groundwater monitoring wells, the methodology for implementing a more rigorous analyses of the existing and to-be-acquired contaminant and hydrogeochemical data, and procedures for comprehensive examination of physical aspects (e.g., water-level responses to pumping) of aquifer interconnectivity. Once the Phase II Investigation is completed, the Permittees must submit a Phase II Investigation Report that shall replace the current Report and synthesize the information obtained during the Phase I and Phase II investigations.

2. Since Cr(VI) contamination in intermediate groundwater in Sandia Canyon is represented by only one well (SCI-2), the Permittees have limited knowledge of the lateral extent of intermediate perched zone saturation, no direct evidence of the direction of groundwater or contaminant flow, and poor understanding of the processes and location by which the SCI-2 groundwater communicates with the regional aquifer. It is uncertain whether this zone is actually in contact with the regional aquifer. Furthermore, one single measurement point (SCI-2) for the entire intermediate zone does not amount to an adequate delineation of Cr(VI) contamination in that zone.

   In order to better determine the extent and concentration of Cr(VI) in the intermediate perched zone, the Permittees must propose to install two intermediate aquifer wells at approximate coordinates 35°51′56.34″ N and 106°15′54.18″ W, and 35°51′47.47″ N and 106°15′56.13″ W. The initial borings for these wells shall be drilled to the base of the Cerros del Rio basalt with continuous coring to total depth. Cores must be analyzed for percent moisture, major ions, anion tracers such as chlorate, and contaminants of concern.

   If Cr(VI) is encountered in either of the two intermediate aquifer wells at concentrations higher than the highest Cr(VI) concentration in the regional aquifer, the Permittees must submit to NMED a work plan for installation of additional intermediate aquifer wells to further assess the intermediate perched zone. The work plan must include details of proposed activities and research that the Permittees will undertake in order to determine the extent of the Cr(VI) reservoir in the intermediate perched zone and its impact on the evolution and fate of the Cr(VI) contaminant plume in the regional aquifer.

3. The lateral extent of the Cr(VI) contaminant plume in the vicinity of the water-table in the regional aquifer has been determined in the eastern and northern directions, and well R-50 should provide data concerning the southern extent of contamination. However, the western and vertical extents of Cr(VI) contamination have yet to be determined. Regional well R-28 is contaminated with Cr(VI) at depths of approximately 40 to 80 ft below the regional water table, suggesting that the vertical component of the plume movement may be significant.

   In order to define the vertical and western extent of Cr(VI) contaminant plume in the regional aquifer, the Permittees must propose to install two regional aquifer wells. One dual-screened regional aquifer well shall be installed near R-28 and screened at approximately 150 ft and 300 ft below the water table. The second dual-screened regional well, with the top screen just below the water table, shall be located at coordinates 35°51′47.47″ N and 106°15′56.13″ W, near the required intermediate well.

4. As part of the Phase II Investigation, the Permittees must: a) measure the vertical and horizontal groundwater flow velocities and directions in all regional and intermediate wells in Sandia Canyon, and those wells in Mortandad Canyon that are either in the vicinity of the Cr(VI) contaminant plume or where detected chromium concentrations are above the relevant background levels; and b) develop a 3-D flow-net model for the regional aquifer in the vicinity of the chromium plume. The vertical and horizontal groundwater flow velocities and directions must be measured using a heat-pulse flow meter, colloidal borescope, or other NMED-approved method. Data and information derived from these measurements must be incorporated into the 3-D flow net model.

5. The Permittees' conceptual model for contaminant transport to the regional aquifer may not reflect the historic hydrologic conditions at the time when high concentrations of Cr(VI), as chromate, were being released. The Permittees' model is based on present-day conditions with respect to surface-water flow rates and alluvial aquifer characteristics such as saturated thickness, lateral extent of saturation, hydraulic gradients, and areas of infiltration to sub-alluvial units. Based on these present-day conditions, the Permittees consider the canyon reach between alluvial wells SCA-2 and SCA-5 as a main infiltration and downward contaminant transport window. However, perennial flow rates and the amount of alluvial material capable of capturing these flows have changed through time. Between 1956 and 1972, the time period of chromate releases, effluent discharges averaged 160,000 gallons per day (gal/day) which is less than half of the present-day releases of 350,000 to 400,000 gal/day. The morphology of the alluvium in the canyon reach between D123.6 and E124 gages has changed since the chromate release period, as evidenced by the significant amount of downcutting that has created a deeply incised channel within older alluvial facies along the above mentioned reach. The alluvial material that was present prior to the downcutting was likely saturated during the chromium release period. Furthermore, the direct-current resistivity profile presented in the Permittees' "*Interim Measures Investigation Report of Chromium Contamination in Groundwater*" (EP2006-1039), page B-28, shows a significant contrast in subsurface conductivity between canyon reaches both west and east of borehole SCC-1. The reach to the west of SCC-1 is the area where downcutting has removed a large volume of alluvial material and where conductivity measurements suggest that the sub-alluvial units may contain faults and/or fracture zones which could be potential infiltration and contaminant-transport pathways.

   Another indication that the primary infiltration zone for chromate-contaminated water was likely upstream of what the Permittees consider the main present-day infiltration zone (the reach between SCA-2 and SCA-5) is that, during the recent sampling of alluvial wells in February 2010, the canyon reach upstream of SCA-2 had flowing water while SCA-2 and all other downstream alluvial wells were dry.

The lower discharge rates between 1956 and 1972, combined with the presence of alluvial material capable of capturing these discharges, likely influenced the distance of perennial flow and the lateral extent of alluvial saturation. Much of the chromate-contaminated source waters available for infiltration may have been located upstream of the current investigation area. Sub-alluvial resistivity data suggest that infiltration pathway(s) likely exist along this reach, and recent sampling of alluvial wells implies continued infiltration in that area. The Permittees must refine their conceptual model for surface contaminant transport and vertical infiltration pathways and present the update in the Phase II Investigation Report.

If new infiltration pathways for chromate releases between 1956 and 1972 are identified by the Permittees, the concentration data for residual chromium in the vadose zone, obtained from core samples collected beneath the present-day infiltration zone, as well as other data obtained from the present-day infiltration zone, may not be representative of the conditions in the infiltration zone for past chromate releases. If this is the case, the Permittees must revise their mass balance and inventory estimates for chromium, using data most representative of the surface and subsurface conditions in the infiltration zone during past chromate releases, and present the update in the Phase II Investigation Report.

6. The Permittees' assessment of the hydrogeochemical aspects of their conceptual model for contaminant transport is focused on trends and distributions of major elements and contaminants of concern. A thorough analysis and evaluation of the contaminant signatures (including stable isotopes, chlorate, bromide, and other contaminant tracers) with respect to the interconnectivity between intermediate and regional groundwater has not been conducted. An adequate characterization of the geochemical evolution along the groundwater flow paths also has not been completed. The Permittees must conduct or refine such analyses and present the results and findings in the Phase II Investigation Report.

7. Analyses of surface-water samples collected at SCS-2 and SCS-3 on July 17, 1994, detected a significant release of chromium, at 760 ug/L, and other trace metals (such as cadmium at 150 ug/L). This information was not provided nor evaluated in the Report. As part of the Phase II Investigation, the Permittees must investigate this release and evaluate the possibility that the Cr(VI) detections in well SCI-2 might represent this chromium release and not the chromate releases that occurred between 1956 and 1972.

8. The 15,000 m^3/yr of infiltration volume beneath the Sandia wetland may only represent 2% of the total release volume for a one year period; however, this was a large volume of water available for potential vertical transport of high concentrations of Cr(VI) and other contaminants during the chromate release period. No direct evidence supports the Permittees' assertion that deep infiltration beneath the wetland was not occurring. In order to determine the moisture conditions beneath the wetland, the Permittees must perform a geophysical survey (e.g., EM, DC resistivity) of the subsurface beneath the wetland and install one boring with continuous coring to a depth of 200 ft (bgs),

preferably in the area of the highest conductivity identified in the course of the geophysical survey. Core must be collected and analyzed for percent moisture, major ions, anion tracers such as chlorate, and contaminants of concern. Data and information collected from this boring must be included in the Phase II Investigation Report.

9. Multiple zones of perched intermediate groundwater were encountered during the installation of regional wells R-10 and R-10a, located in the lower reaches of Sandia Canyon. For example, an abundance of perched groundwater discharging from "Old Alluvium" at a depth of 338-340 ft was observed in the open-borehole video log for R-10a. Water-quality screening data for perched intermediate groundwater samples suggest that contamination is present, as evidenced by elevated nitrate, sulfate, nickel, and other constituents. Deionized leachate data (see Plate 6 from the Report) for soluble chromium and molybdenum obtained from a core collected during the drilling of R-12, located upgradient of R-10 and R-10a, suggest that a significant flux of chromium and molybdenum migrated through the vadose zone beneath R-12 at depths ranging from 140 to 600 ft bgs. In order to determine the presence and concentration of contaminants in the perched aquifer encountered at R-10 and R-10a, and any link to the high chromium and molybdenum in the vadose zone observed at R-12, the Permittees must propose to install one intermediate zone characterization well at the R-10/R-10a location. Data and information collected from this well must be included in the Phase II Investigation Report.

10. The assertion by the Permittees in the Executive Summary that "this finding is consistent with the lack of evidence of past transport of Laboratory-derived contaminants from Sandia Canyon to the Rio Grande" is not supported by evidence. It is likely that contaminants originating from the many contaminant sources in Sandia Canyon have migrated to the Rio Grande. Field observations made by NMED staff in the lower reach of Sandia Canyon from the Laboratory boundary to the Rio Grande suggest, with high confidence, that active storm-water flow and sediment transport does enter the Rio Grande along this reach. In addition, concentrations of chromium, nickel, and uranium above background have been reported (see RACER database) from the annual surveillance sediment station Sandia at Rio Grande. The Permittees must propose to review data from sediment stations and from sampling of Rio Grande sediment in the Phase II Investigation Work Plan, and provide the results and findings, regarding possibility of sediment transport from Sandia Canyon to Rio Grande, in the Phase II Investigation Report.

11. Within the canyon bottom and approximately 2000 ft east of supply well PM-3 exists a large alluvial fan-type deposit of unknown thickness. It appears that the gradient of the canyon floor decreases along this area to a point at which flood waters and associated sediments splay laterally away from the active channel and onto the floodplain. This feature was not characterized as part of this investigation. As part of the Phase II Investigation, the Permittees must propose to collect surface and subsurface samples of

this sedimentary package, analyze them for full-suite analyses of inorganic and organic compounds, and report results in the Phase II Investigation Report.

12. NMED views the characterization of Sandia Canyon as incomplete because additional investigation is necessary. Development of risk assessments based on an incomplete dataset is not appropriate. Therefore only a preliminary review was conducted by NMED since it is likely that the additional investigations will provide additional data relevant to the risk assessments.

    The following issues were noted during the preliminary review that must be addressed in an updated risk assessment to be included in the phase II investigation report.

    a. In the discussion of the ecological/biota assessments, it is noted that for non-detects, a simple substitution method using a value of zero was applied. While use of simple substitution for non-detects has been acceptable in the past, current studies have shown that simple substitution results in several errors. As such, EPA does not recommend the use of simple substitution but rather recommends the use of regression on order statistics (ROS) to extrapolate non-detects. A maximum likelihood estimation (MLE) test and the Kaplan Meyer test, both ROS methods, have been found to be more accurate for determining statistics for data containing non-detects. Estimations of exposure point concentrations must be revised to incorporate ROS methods for handling non-detects in datasets. It is noted that appropriate methods for handling non-detects were applied in Appendix E for the risk assessments; therefore, this issue only applies to assessment of the biota data. Additional guidance on this issue may be found in the following:
       - Environmental Protection Agency's (EPA), ProUCL Version 4.00.02 User Guide, EPA/600/R-07/038, April 2007.
       - EPA ProUCL Version 4.00.04
       - Dennis R. Helsel, More than Obvious: Better Methods for Interpreting Non-detect Data, *Environmental Science and Technology*, October 15, 2005.

    b. Avian toxicity to dioxins/furans was not included in the assessments (see Table E-1.2-1). In past discussions with the Permittees, the exclusion of avian toxicity reference values (TRVs) was because the values were based on studies that used subcutaneous (intraperitoneal) injections (i.p.) (reference also to study posted in Sample, *et.al* 1996: Toxicological Benchmarks for Wildlife: 1996 Revision). The document, "Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife: DDT, Mercury, 2,3,7,8-TCDD, PCBs" (EPA 820-B-95-008, March 1995), specifically states in the discussion of avian chronic and subchronic toxicity for 2,3,7,8-TCDD (Chapter 3) that "…it generally is acknowledged that i.p. and oral routes of exposure are similar because in both instances the chemical is absorbed by the liver, thereby permitting first-pass metabolism. Use of the i.p. dose levels assumes that 2,3,7,8-TCDD bioavailability and absorption form the gastrointestinal tract and the abdominal cavity are not significantly different (USEPA 1993)." The Report does indicate that there is potential for both over- and under-estimation of absorption that would be assumed through ingestion, which should be discussed in the uncertainty analysis of the risk assessment. Given the above, the no-observed adverse effect level (NOAEL) of 1.4E-02 μg/kg/day using the ring-necked pheasant by Nosek et al 1992 (as cited in the above referenced document) and as cited by Sample et al 1996), it is appropriate to use i.p. data for deriving a TRV for avian receptors. Use of any uncertainty factors that may be applied to derive a final TRV should be discussed in the risk assessment. Revise the assessment to include an evaluation of potential risk to avian receptors accordingly.

c. Section 8.2.6.3 of the Report indicates that Region 6 Medium Specific Screening Levels (MSSLs) from 2007 and Region 9 Preliminary Remediation Goals (PRGs) from 2004 were applied in the risk assessment. It is not clear why screening levels from these two databases would be applied in the risk assessment. Both the Regional Screening Levels (2009) and the NMED Screening Levels (2009) should be used and should address all contaminants of concern. In the event that a screening level is not available in one of these two tables, a site-specific screening level should be calculated using the methodology outlined in the NMED Soil Screening Guidance. Significant changes to how exposure is determined (e.g., inhalation) have been incorporated into the guidance since the MSSL and PRG documents were published. The Permittees must clarify this issue and revise accordingly.

d. The primary current and future receptor for the human health risk assessment was identified as a recreationalist. The residential scenario was conducted for background purposes only. As noted in Section 1.4 of the Report, portions of the canyon located down-canyon from Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) are used by the Pueblo of San Ildefonso for various traditional uses. As noted in evaluations for other areas at the facility that have been found to impact Pueblo land, it has been determined that one of the uses for the areas is hunting. In reviewing the constituents of potential concern (COPCs) carried forward in the risk assessments, several of the COCs show a tendency to bioaccumulate. As such, risks to the people of the Pueblo de San Ildefonso via ingestion of potentially contaminated game via a subsistence hunting scenario should have been identified as a current and reasonably foreseeable future land use in the canyons and should have been evaluated. The Permittees must revise the assessments to include an evaluation of the subsistence hunting scenario.

e. Updates to the NMED screening levels for the polycyclic aromatic hydrocarbons (PAHs) were made in December 2009. These updates must be considered as part of the revisions to this Report.

13. The current Report includes numerous inaccuracies, omissions and internal inconsistencies. Listed below is a small sample of such errors:
    a. Section 3.2.2 (Piezometer Installations) states that piezometers SCP-1a, SCP-1b, and SCP-1c are shown on Plate1 but they are not shown on Plate 1.
    b. Section 3.2.3 (Vadose-Zone Characterization Core holes) describes SC1 through SC5 as core holes. However, on Plate 1, they are not shown as core holes but as intermediate-depth perched groundwater wells or boreholes.
    c. Section 3.3-1 (Chemistry of Archival Vadose-Zone Core Samples) refers to SC core holes in Sandia Canyon as SC2-AHF through SC5-AHF but the same core holes are called SC2 through SC5 in Section 3.2.3 and on Plate 1.
    d. Section 4.2.3 (Vadose-Zone Characterization Core holes), page 22: The sentence "Details about the field investigations associated with the installation of these core holes are provided in." is incomplete, i.e., the reference is missing.
    e. Section 4.2.8 (Water Balance Investigation) states that three temporary gages were installed between gages E123 and E124. However, Section 3.2.8 states that two temporary gages were installed in that stream segment.
    f. Section 5.4 (Water Quality Standards and Screening Levels) references 20.6.4.4.126 NMAC but no such section of the NMAC exists.
    g. Table 3.2-1 (Sandia Canyon Surface and Groundwater Sampling Locations and Rationale) does not include gaging station E123.5, even though this station is shown on Fig. 3.2-1 and Plate 1 as a sampling location.
    h. Table 3.2-1(Sandia Canyon Surface and Groundwater Sampling Locations and Rationale) lists well TA-53i which is not shown on Fig. 3.2-1 or Plate 1. However, both Fig. 3.2-1 and Plate 1 depict well TA-53-1(i) which is not included in Table 3.2.-1.
    i. Table 6.1-1 (Water Screening Location, Synonym and Reach): There are numerous inconsistencies between this table and Table 3.2-1 that must be resolved or explained.
    j. Table 6.3-22 (Inorganic COPCs in Filtered Nonstorm-related Surface Water Samples) lists W2CS as a synonym for the sampling station SCS-2. However, Table 6.1-1, which lists synonyms for each sampling location, does not list W2CS as a synonym for SCS-2.

The Permittees must submit a Phase II Investigation Work Plan that proposes actions to conduct further investigation and data evaluation to address the comments in this letter. The Permittees must submit the work plan to NMED no later than May 21, 2010.

Should you have any questions, please contact Jerzy Kulis of my staff at (505) 476-6039.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

BRZ:jk

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